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FISHES OF ARAVAIPA CREEK, GRAHAM AND PINAL COUNTIES, ARIZONA

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ABSTRACT.—Aravaipa Creek in Graham and Pinal counties, Arizona, is a now-isolated, spring-fed tributary of the San Pedro River. This stream acts as a refugium for 7 of the 12 known native fish species of the San Pedro drainage (*Gila robusta, Rhinichthys osculus, Agosia chrysogaster, Tiaroga cobitis, Meda fulgida, Catostomus insignis,* and *Pantosteus clarki*). Only two introduced fishes are present (*Ictalurus melas* and *Lepomis cyanellus*), and these are restricted to a pond lateral to the creek.

Increasing demands on water in the American Southwest, along with changes in land use, possibly climate, and other factors, have had adverse effects on the native aquatic fauna (Miller, 1961, *et seq.*). A substantial percentage of natural marshes, springs, and streams already are modified beyond reclamation; only a few enjoy relative immunity. In addition, animals in the West have been increasingly subject to competition from a myriad of exotic animals (Miller, 1961; Deacon, et al., 1964; Hubbs and Deacon, 1964; and others). All this contributes to marked modification of the distribution and abundance of native fishes, and to their decline and extinction in some instances.

One of the few aquatic habitats that has maintained relative virginity is Aravaipa Creek, Graham and Pinal counties, Arizona. In this paper we record some collections of fishes from that stream, including results of our intensive survey of the fishes between 6 November 1964 and 1 May 1965. Charles H. Lowe and Wallace G. Heath, University of Arizona (the latter now at Western Washington State College), studied Aravaipa Creek in the 1950's, with special reference to thermal ecology of the fishes. Results of their studies are soon to be published elsewhere.

TOPOGRAPHY AND GEOLOGY OF THE AREA. Aravaipa Creek drains the northwest end of a structural trough that to the south holds the Willcox Playa (a remnant of Pluvial Lake Cochise; Cole, 1963), and the extreme headwaters of the south-flowing Río Yaqui of México. It originates at a low divide about 1,310 meters (m.) above mean sea level, passes northwest for 75 linear kilometers (km.) (*ca.* 140 km. by actual stream channel), to enter the now-dry San Pedro River at an elevation of 660 m., 16.8 km. south-southeast of Winckleman, Arizona (Fig. 1). Only about 50 creek-km. of the channel holds permanent surface water.

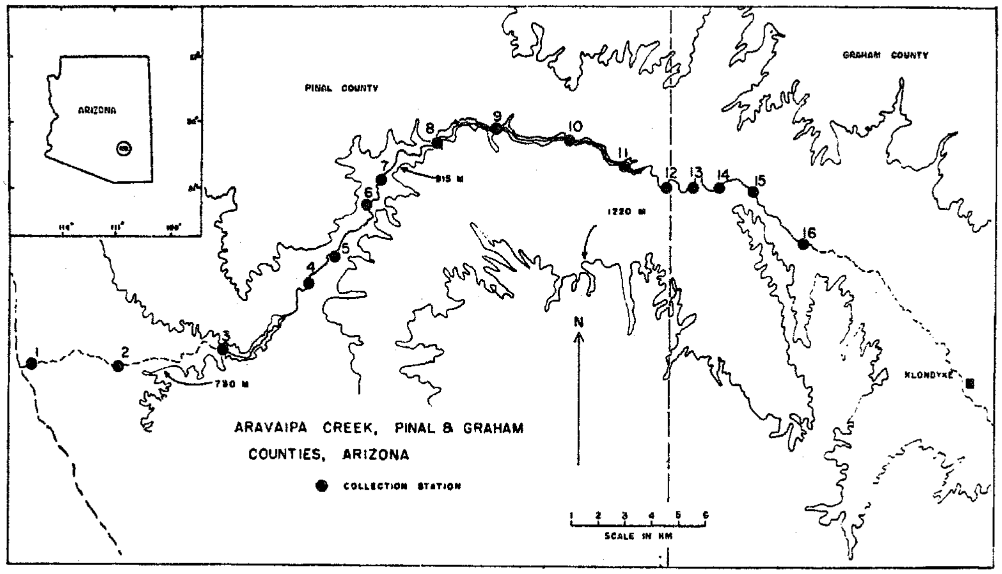

Fig. 1. Sketch map of Aravaipa Creek, Arizona, showing collection stations.

The creek rises from a gravelly channel 6 km. northwest of Klondyke, in a broad valley bordered on the east by the Santa Teresa Mountains, and on the west by the Galiuro Mountains. The valley ranges to more than 10 km. wide and has been cut to a depth of 600 m. in Pliocene, Pleistocene, and Recent sediments (Ross, 1925). The floodplain in the area ranges to two km. wide. The valley has imperfectly-preserved remnants of two terraces high on its slopes; a third terrace is formed along the course of the present channel. About eight km. downstream from Klondyke (Fig. 1), the stream enters a steep-walled canyon cut in Tertiary andesites and Pre-Cambrian dibasic rocks of the north end of the Galiuro Range (Ross, 1925; Wilson and Moore, 1959). Within the canyon, walls often exceed 250 m. in height and the channel is narrow and tortuous. Near the San Pedro River the canyon widens and the creek passes again onto Pliocene to Recent sediments of the dissected western bajada of the Galiuros.

CLIMATE AND VEGETATION. Temperatures in the Aravaipa area range from less than — 5° to more than 38.0° Centigrade (C.); temperatures in summer are high, but not so extreme as in more central parts of the State. Coolest weather is in January and warmest in June and July. Records of rainfall at Klondyke in 1915–16 indicated about 50 centimeters (cm.) per year (Ross, 1925), but the actual average is probably lower than this.

Aravaipa Creek heads in grassland dotted with sparse juniper (*Juniperus*). Its lower course passes through typical montane, Upper Sonoran vegetation, dominated by cacti, creosote bush (*Larrea*) and grasses. Along the stream terraces are thick groves of mesquite (*Prosopis*).

ARAVAIPA CREEK.—Gradient in the channel above the canyon that has permanent flow is about 5.7 m./km. (calculated from U. S. Geol. Surv. Maps, 1943, 1949). In the canyon gradient averages 8.2 m./km. Currents are swift, more than one m./second in riffles and less than five cm./second in pools. Riffles range from 3 to 5 m. wide, narrowest in the canyon and broadest in the often-braided, sandy channel downstream, and are 5 to 35 cm. deep. Turbulence is negligible over sand bottoms to extreme where boulders interrupt flow. Pools, mostly behind man-made irrigation diversions, are to 150 m. long and 15 m. wide, with deepest water less than 1.5 m. in the mainstream. Natural pools occur near cliffs and adjacent to obstructions; these rarely exceed two m. wide, five m. long, and 0.5 m. deep.

In 1919–21, a discharge gauge was on a concrete ford near the mouth of Aravaipa Creek, presumably at the crossing of the present Highway 77. Mean discharge in 1920 was 0.61 cubic m./second ($m.^3$/second), and in 1921, 0.95 $m.^3$/second. In the period 1932–38, records at a gauge located near the mouth of the canyon ranged from an annual mean of 0.50 $m.^3$/second (1938) to 1.46 $m.^3$/second (1935); the average for the seven-year period was 0.79 $m.^3$/second (U. S. Geol. Surv., 1947). Most discharge comes from springs, with little water contributed from surface runoff or seepage from the 1,200 square km. drainage area, except during heavy rains. Occasional severe flooding is indicated by debris accumulated three m. above normal water level in the canyon. Flood water sometimes passes into the San Pedro River in considerable volume.

During our survey no variations in discharge that could be attributed to rainfall occurred, even though rainfall was recorded. The entire section of permanent water was examined—two slightly-flowing tributaries were in Virgus and Horse Camp canyons. Variations in discharge at downstream stations on 6 November 1964 were from 0.34 to 0.68$m.^3$/second, using the Embody (1927) cork-float method for estimates. Smaller discharges were in areas of unconsolidated bottom materials (gravel, sand, or boulder); greatest volumes were where bedrock bottoms or natural dikes occurred. Some variations were attributable to irrigation diversion to the floodplain. The creek rarely flows near Highway 77 where the gauging station was located in 1919–21.

Below the highway extensive marshes once occurred along the creek and along the San Pedro River. This is documented by a high incidence of malaria in personnel at Camp Grant (located near the mouth in the 1870's and 1880's), by data on contested water rights, trappers records, and news accounts (see Hastings, 1959). Fred Woods (*pers. comm.*) verifies the presence of marshes and stated that extensive stands of Sacatón grass (*Sporobolus*) along the creek were replaced by mesquite in early 1900. The major vegetative change in southern Arizona since the 1870's, expansion of mesquite, is well documented (Hastings, 1959; Lowe, 1964; many others).

Irrigation along the Aravaipa explains, in part, changes that have occurred. In 1941, about three km^2. of the downstream floodplain were under irrigation, with a slightly greater irrigated area estimated in 1919–21 (U. S. Geol. Surv., 1947). Present use seems similar in the lower valley to that reported in 1941.

Near Klondyke we noted pumps removing sub-surface waters for irrigation in 1964–65. These are presumably recent and their effect on the stream are yet to be determined. However, according to Heindl, *et al.* (1952), wells have been used for irrigation in the upper valley for at least 40 years. Woods (*pers. comm.*) has noted no diminution in average flow at his ranch as a result of pumping. About 12.5 km^2. of land was under cultivation in the upper valley in 1941 (Heindl, *et al.*, 1952).

In our survey, water temperatures ranged from 8.9° C. in December, at about noon, to 20.6° C. on 6 November 1964, at 4:00 P.M. Summer temperatures substantially exceed our upper value, sometimes resulting in fish mortality (Heath, *pers. comm.*). However, because of percolation and exchange of surface water in desert streams with that moving beneath the coarse sediments of the stream-bed, water temperatures often remain moderate, no more than 27° C. in many instances, despite extreme summer isolation and air temperature (unpublished data).

Shading by high cliffs and thick riparian vegetation along the canyon part of Aravaipa Creek ameliorates summer temperatures. Sand, gravel, and boulder banks support dense stands of shrubs (mostly *Baccharis*) along the water's edge, with a gallery of cottonwood (*Populus*), sycamore (*Platanus*), willow (*Salix*), ash (*Fraxinus*), and box elder (*Acer*) occurring for a short distance up the banks. More xerophilic trees, walnut (*Juglans*), oak (*Quercus*), mesquite, and acacia (*Acacia*) occur back from the water, adjacent to desert plants of higher slopes. Lowe (1964) and van Campen (1965) published photographs of the stream and its environs.

Bottoms in the creek are made up almost entirely of unconsolidated, stony materials, except where cliffs reach the water. No aquatic vegetation, other than sparse watercress (*Nasturtium*) and filamentous algae, occurs.

The water was slightly turbid on all our visits, colored light brown by extremely fine, suspended silt, and is hard judging from a few nodules of marl deposited on riffles. Ground water of the lower San Pedro valley usually contains less than 600 milligrams per liter (mg./1.) of dissolved solids, but range as high as 9,000 mg./1. Some waters in the Aravaipa basin contain more than 1.5 mg./1. flouride

(Heindl, 1952). There was no evidence of organic pollution in the Aravaipa during our study.

TECHNIQUES AND COLLECTING STATIONS. Most collections were made by seines that ranged from the 1.2-m. "common-sense" type with 0.32-cm. mesh, to an 18-m., tied bag seine with 0.64-cm. mesh. Experimental gill-nets ranging from 16 to 40 m. long, with meshes (bar measure) from 1.27 to 3.8 cm., were used in irrigation impoundments and in the artificial pond that comprised our Station 4.

Sites and dates, and the name of the person in charge of notes are given below for each collection studied by us. Stations 1–12 are in Pinal County and 13–16 in Graham County. Localities are numbered consecutively from down- to upstream. All but Station 4 were in the main channel of the creek, with Station 4 being an artificial pond lateral to the creek and fed by irrigation diversion. We have placed collection sites of persons other than ourselves as accurately as possible within the following legal descriptions: Station 1.—Center E ½, Sec. 9, T–7S, R–16E, 10 April 1963, Elena T. Arnold. Station 2.—SE ¼, NE ¼, Sec. 11, T–7S, R–16E, 6 November 1964, Barber. Station 3.—NE ¼, NW ¼, Sec. 8, T–7S, R–17E, 17 April 1964, Minckley; 6 November 1964, Barber. Station 4.—Center Sec. 34, T–6S, R–17E, 27–28 February 1965, Barber. Station 5.—SW ¼, SW ¼, Sec. 26, T–6S, R–17E, 17–18 April 1964, Minckley. Station 6.—Center SE ¼, Sec. 23, T–6S, R–17E, 17–18 April 1964, Minckley; 6 November 1964, Barber. Station 7.—SW ¼, NW ¼, Sec. 24, T–6S, R–17E, 31 October 1943, James R. Simon; 6 November 1964 and 28 February 1965, Barber. Station 8.—SE ¼, NW ¼, Sec. 18, T–6S, R–18E, 23 December 1964, Barber. Station 9.—Center NE ¼, Sec. 17, T–6S, R–18E, 23 December 1964, Barber. Station 10.—SW ¼, NE ¼, Sec. 15, T–6S, R–18E, 22 December 1964, Barber. Station 11.—SE ¼, Sec. 24, T—6S, R–18E, 22 December 1964, Barber. Station 12.—E ½, Sec. 24, T–6S, R–18E, 1 May 1965, Barber. Station 13.—Center Sec. 19, T–6S, R–19E, 10–11 May 1950, Robert R. Miller; 21 December 1964, Barber. Station 14.—SE ¼, NW ¼, Sec. 20, T–6S, R–19E, 21 December 1964, Barber. Station 15.—NW ¼, SW ¼, Sec. 21, T–6S, R–19E, 21 December 1964, Barber. Station 16.—W ½, Sec. 27, T–6S, R–19E, 21 December 1964, Barber.

ACCOUNTS OF SPECIES.—Collections of fishes from the Aravaipa all have been made in the last 25 years. Specimens are housed at the University of Michigan Museum of Zoology (UMMZ), the Department of Zoology, Arizona State University (ASU), and at the Department of Zoology, University of Arizona.

Gila robusta Baird and Girard, roundtail chub: This large minnow was taken in our survey at Stations 5–7, 12 and 13. Specimens of *G. robusta* from Aravaipa Creek tend toward *G. r. robusta* based on the characterization of that subspecies by Miller (1946), but a tendency toward *G. r. intermedia* (Girard) also is apparent (Table 1). In addition to data in Table 1, scales in the lateral-line of 54 specimens from Aravaipa Creek ranged from 73 to 86 (mean 78.6). In 31 *G. r. robusta* from the Salt and Verde rivers and from canals in Tempe, Arizona, we count 77 to 92 scales in the lateral-line (mean 83.9) and 46 *G. r. intermedia* from southern and central Arizona have 54 to 78 scales (mean

TABLE 1

Frequencies of certain characteristics of Gila robusta *from Arivaipa Creek, compared with those from other localities in Arizona; counts and measurements made following Hubbs and Lagler (1958)*

Localities	Dorsal fin-rays				Anal fin-rays					Caudal peduncle depth/head length							
	7	8	9	x̄	7	8	9	10	x̄	2.4–2.5	2.6–2.7	2.8–2.9	3.0–3.1	3.2–3.3	3.4–3.5	3.6–3.7	x̄
G. r. robusta[1]																	
Canals, Tempe, Maricopa Co.	..	..	22	9.00	..	..	22	..	9.00	..	..	..	5	7	9	1	3.5
Verde R., Yavapai Co.	..	1	24	8.96	..	..	25	..	9.00	..	..	..	4	3	2	..	3.2
Salt R., Gila Co.	..	..	40	9.00	..	1	38	1	9.00	..	..	..	..	7	12	5	3.5
G. robusta[2]																	
Aravaipa Creek	..	10	44	8.81	..	16	38	..	8.70	..	..	8	30	12	3	1	3.1
G. r. intermedia[3]																	
Monkey Spring, Santa Cruz Co.	1	48	..	7.98	4	45	..	..	7.92	1	5	22	19	2	..	..	2.9
Cave Cr., Maricopa Co.	..	27	..	8.00	7	20	..	..	7.74	4	4	6	..	..	..	..	2.6
Oak Cr., Coconino Co.	..	17	..	8.00	4	13	..	..	7.76	3	12	2	..	..	..	..	2.8
Fish Cr., Maricopa Co.	2	35	..	7.95	1	36	..	..	7.97	1	12	21	3	..	..	..	2.7

[1] Tempe canals, ASU 1495, 1513; Salt R., UMMZ 162760, ASU 1373; Verde R., UMMZ 162827, ASU 496, 2156.
[2] Aravaipa Cr., ASU 664, 670, 1598, 1625, 1634, and uncataloged.
[3] Monkey Spring, ASU 599; Cave Cr. UMMZ 162841, ASU 480, 2162, 2164; Oak Cr., ASU 494; Fish Cr., ASU 474.

67.8). On these bases we refer the Aravaipa population of *G. robusta* to intergrades, *G. robusta: robusta* × *intermedia.*

Roundtails require pools in which to live. Movement of sand into streams of the Southwest, during and following an erosion cycle of the late 1800's (Hastings, 1959; Miller, 1961; and others), probably decimated populations of this species, even in streams that maintained permanent flow. Largest populations in the Aravaipa were in pools behind irrigation diversions. We caught 39 adults, 56 to 182 mm. standard length, by gill-net from such a pool at Station 5. Sixty-one (UMMZ 141721; 41–204 mm. standard length) were obtained by Simon from near our Station 7 in 1943. His field notes (at UMMZ) record water to 1.2 m. deep, but mention no man-made obstructions in the stream. In Aravaipa Canyon, we caught only six *G. robusta* in our largest collection of the species from a single station. They occurred in small eddies behind boulders, in pockets beneath ledges, and in occasional pools near canyon walls. In relative terms, *G. robusta* was consistently uncommon throughout the creek (Fig. 2).

Rhinichthys osculus osculus (Girard), speckled dace: We obtained one immature specimen of *R. osculus* at Station 14. Simon took a single, 30 mm. specimen near Station 7 in 1943, and in 1950, Miller preserved 35 individuals, 8–50 mm. long, from near our Station 13 (UMMZ 141723 and 162753, respectively). The specimen is assigned to the typical subspecies on geographic grounds; the type locality is Babocomari Creek, just north of Fort Huachuca in the San Pedro drainage (Girard, 1856).

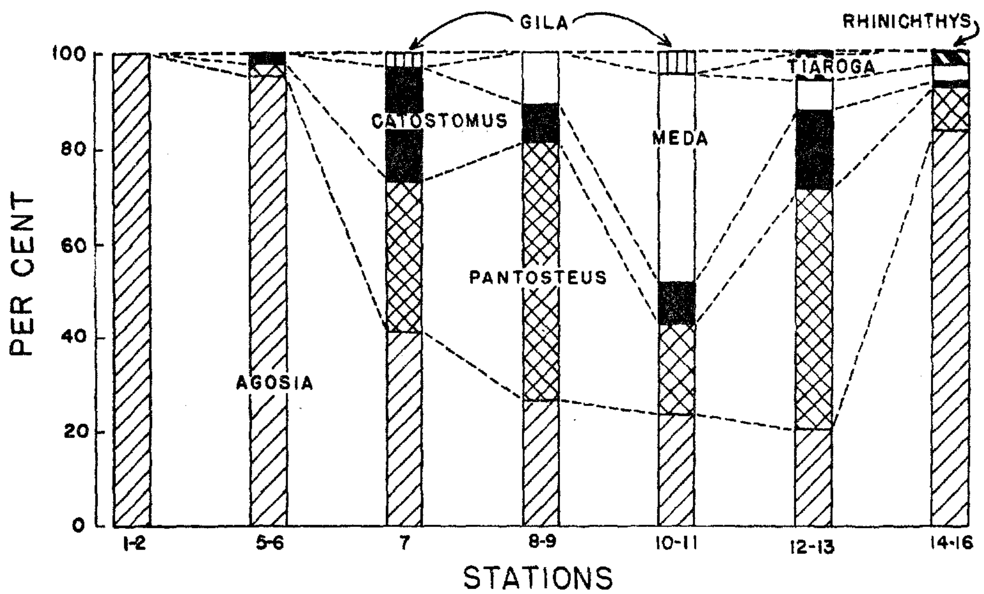

Fig. 2. Relative abundance of seven species of native fishes at selected stations or station-areas of Aravaipa Creek, Arizona.

Agosia chrysogaster Girard, longfin dace: Longfin dace comprised 100 per cent of the fauna at Stations 1–2, and more than 80 per cent at Stations 5–6 and 14–16 (Fig. 2). The sharp decrease in its relative abundance in the canyon may be attributed to an actual decrease in numbers in the high-gradient, rocky part of the channel, and to increases in relative abundance of other species. *Agosia* is characteristic of sandy desert streams; it is "the species of Arizona that persists longest in the dwindling waters of sandy streams. . . . [Miller, 1961]." Young *A. chrysogaster* disperse rapidly downstream into normally-intermittent parts of streams when the opportunity presents itself, and persist for an amazing length of time under severe environmental conditions.

Schools of *Agosia* frequented shallow, sandy pools in moderate current; however, some individuals moved along the edges of swift riffles. Young fish are most common along the banks and in shallow eddies. Large adults seek pools along with *G. robusta*, and have a marked proclivity for concealment in algal mats or other cover. We obtained as many as 150 individuals of this species in a single seine haul. Both Simon and Miller obtained large numbers of *Agosia* in their earlier collections from the stream.

Tiaroga cobitis Girard, loach minnow: The monotypic genus *Tiaroga* is restricted to the Gila River basin in Arizona, New Mexico, and Sonora, México. It is becoming increasingly rare throughout most of its range, and was uncommon in the Aravaipa. We found one specimen at Station 11, the fish was most abundant at Stations 13–14, and seven young-of-the-year were obtained at Station 16 in May. The collection by Simon of six adults near our Station 7 (UMMZ 141724; 32–48 mm. standard length), and by Miller of 106 specimens near Station 13 (UMMZ 162754; 8–50 mm.), may indicate spatial and numerical decreases in the abundance of this fish since 1943 and 1950. Our total catch of *T. cobitis*, including those retained alive for other studies, was 53 individuals. The only other stream in which we know a substantial population of this species persists is the mainstream of the Gila River, New Mexico (Minckley, 1965).

Tiaroga inhabits riffles, generally in areas of turbulence and a rich growth of epilithic, filamentous algae (Miller and Lowe, 1964; Minckley, 1965). In Aravaipa Creek, perhaps because of the season, algae was scarce on riffles. The fish was found only in areas of coarse gravel/small rubble bottoms, and in water less than 20 cm. deep. Seine-hauls that included *Tiaroga* generally contained no other species of fish. Winn and Miller (1954) describe and illustrate the post-larva of *T. cobitis* from specimens caught in Aravaipa Creek.

Meda fulgida Girard, spikedace: We found spikedace at Station 6 (in April, but not in November), and at Stations 8, and 10–14; it made up a substantial proportion of the samples in the upper part of the canyon (Fig. 2). *M. fulgida* seems to prefer moving water less than one m. deep when such is available, living in deep, swift pools or near the downstream ends of riffles (Miller and Hubbs, 1960). Most specimens obtained by us were on "flat" (uniformly turbulent) riffles, however, and generally in water less than 30 cm. deep. In April 1964, we found the fish on shallow, 10-cm. riffles, over gravel, in water flowing more than 70 cm./second. Neither Simon nor Miller caught this species in their collecting; however, many specimens are at the University of Arizona.

Meda is second of the two endemic genera of the Gila River basin, and, as with *Tiaroga*, has suffered marked reductions in over-all range in the past few years.

Catostomus insignis Baird and Girard, Sonora sucker: *C. insignis* is a large, coarse-scaled, bicolored sucker that is widely distributed in the Gila and Bill Williams drainages of Arizona. In Aravaipa Creek, it was frequent in occurrence, comprising a significant part of the fauna at stations upstream from the intermittent, lower area (Fig. 2). It was most common in pools behind irrigation diversions, and also occurred in the artificial pond at Station 4. It was found on deep riffles, but not so frequently as the following sucker, and was very rarely in shallow, turbulent areas. All specimens seined in turbulent waters were small in size.

Pantosteus clarki (Baird and Girard), Gila sucker: This sucker reached its peak of abundance in Aravaipa Canyon (Fig. 2), but was present at all stations upstream from 1 and 2. Large individuals occur in pools, less frequently on riffles. Small adults and young are predominately riffle fish, especially over gravel/rubble bottoms. Very young individuals of this, and the preceding species, live in warm, quiet backwaters along the stream, moving into faster waters as juveniles, then into riffles or pool and pool-like areas as adults.

Hybrids, *Catostomus insignis* × *Pantosteus clarki*: Three specimens of this hybrid combination were identified from Stations 6, 11, and 16. This cross has frequently been encountered in streams of the Gila River basin (Hubbs, et al., 1943; Miller and Lowe, 1964).

Ictalurus melas (Rafinesque), black bullhead: Seven specimens of the introduced black bullhead were obtained from the pond (Station 4). This species was introduced into the Colorado River basin prior to 1904 (Miller and Lowe, 1964), and has presumably been dispersed by man to the disjunct drainage of the State. Relative swiftness of current and lack of muddy pools in the Aravaipa make it unlikely that a large population of bullhead catfish will establish.

Lepomis cyanellus Rafinesque, green sunfish: Three *L. cyanellus* were gill-netted from Station 4. The proclivity of this animal for slow current and deeper, well-protected pools, should limit its invasion of the mainstream. As with the bullhead, this form is widely transported by man, presumably in attempts to establish sport fisheries.

SPECIES OF HYPOTHETICAL OCCURRENCE.—In addition to the nine species and one hybrid collected in our survey, largemouth bass, *Micropterus salmoides* (Lacépède), are said to occur in the pond at Station 4. In 1943, Simon obtained 94 specimens of the Gila topminnow, *Poeciliopsis occidentalis* (Baird and Girard), from the San Pedro River about 6.4 km. north-northwest of Feldman. That town was located about 3 km. downstream on the San Pedro from the mouth of Aravaipa Creek. The topminnow, and the desert pupfish (*Cyprinodon macularius* Baird and Girard) probably were present in lower Aravaipa when permanent marshes existed.

SUMMARY AND DISCUSSION.—Aravaipa Creek in Graham and Pinal counties, Arizona, is a now-isolated, spring-fed tributary of the San Pedro River, which acts as a refugium for seven species of native fishes. Two introduced fishes also were obtained in our survey.

In the relatively depauperate fauna of the Southwest, few congeneric species are sympatric. This helps to explain the extreme habitat separation, at the intrafamilial level, found in these fishes. Each minnow, for example, occupies relatively distinct habitat, with overlap occurring in ontogeny of species life-histories. *Gila* is a deep-pool fish, *Agosia* occurs mostly on flat, sand bottoms in shallow pools, *Meda* inhabits eddies and swift areas below riffles, and *Tiaroga* is restricted to riffles, much like the small percids (*Etheostoma* and others) of eastern North America. Of the fishes obtained in the Aravaipa, only *Rhinichthys* has habitat that appears to overlap other forms, that of *Tiaroga* on one side, and perhaps that of *Meda* on the other. However, on riffles, *Rhinichthys* tends to swim actively above the substrate while *Tiaroga* is on the bottom; in pools, *Meda* is more of a mid-water fish than *Rhinichthys*. No species of fish has been introduced in the Aravaipa that disrupts this pattern. Disruption is the case in many Arizona streams, especially where the red shiner, *Notropis lutrensis* (Baird and Girard), is established (unpublished data).

Aravaipa Creek therefore provides habitat for seven of the 12 known native species of fishes from the San Pedro drainage (see Miller, 1961; Miller and Lowe, 1964). Fishes that do not persist in the Aravaipa, *Ptychocheilus lucius* Girard (Colorado squawfish), *Catostomus latipinnis* Baird and Girard (flannelmouth sucker), *Xyrauchen texanus* (Abbott) (Humpback sucker), *Cyprinodon macularius*, and *Poeciliopsis occidentalis*, either are characteristic of large, swift-flowing waters (first three), or require quiet, protected marshes or inlets (last two). The first three fishes may never have occurred in the creek and the last probably were present in the past. No other stream known to us in Arizona supports so large a segment of the aboriginal fauna in the absence of substantial numbers of exotic forms.

Habitats in Aravaipa Creek may have changed little in the last few years, except near the mouth and perhaps through entrenchment in the upper part of the stream. Recognition of this relative lack of change, and of the fact that the undisturbed area can be maintained as a reserve for the native animals remaining there, thereby allowing preservation of part of a unique native fauna (that is fast disappearing) for study and appreciation by subsequent generations, is imperative.

Our collection from Aravaipa Creek all were made with the assistance of persons from Arizona State University; we thank them all. Robert R. Miller, University of Michigan Museum of Zoology, provided accommodations for Minckley at that Institution, and has offered encouragement and information. Landowners along the stream deserve special thanks, especially Fred Woods of the Panorama Ranch. Arizona Game and Fish Department granted necessary permits for collection of fishes. The study was supported in part by grants to Minckley from the University Research Committee of Arizona State University and from the Sport Fishing Institute.

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